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Forest Health Protection
Pacific Southwest Region

Date: September 16, 2011

File Code: 3420

To: District Ranger, American River RD, Tahoe National Forest

Subject: Insect and Disease Evaluation of six stands in the Biggie Project (FHP Report #NE11-13)

On August 9, 2010 at the request of Kelly Pavlica, Silviculturist, American River RD, Forest Health Protection (FHP) Entomologist Danny Cluck and FHP Plant Pathologist Bill Woodruff evaluated six forest stands within the Biggie Project area. Ms. Pavlica and Kelly Hack, District Culturist, participated. The objectives of this evaluation are to provide insect and disease information, identify the current forest health conditions within the Biggie Project area and discuss the influence these conditions would have on stand management objectives. Recommendations are provided where appropriate.

Biggie Project Sites Evaluated and Project Objectives

The sites evaluated were the Big Trees giant sequoia grove and five nearby stands on south Mosquito Ridge (T14N; R12 and 13E, Mt. Diablo Meridian). The elevation is between 5200' and 5700' and the average annual precipitation ranges between 50 and 60 inches. Project objectives include improving tree resilience to better withstand the effects of insects and disease in a changing climate, remove ground and ladder fuels to minimize damage from wildfire and to protect the six old growth giant sequoia trees in the Big Trees Grove.

Site 1 – Big Trees Grove (Pictures from the grove are included in Appendix 1)

This mixed conifer old growth stand contains six specimen giant sequoia trees. Big Trees Grove is the northern-most native giant sequoia grove in California. The two largest sequoias in the grove, the Joffre and Pershing trees have full, healthy-looking crowns and are estimated to be over 1000 years-old. At least two very large and very old fallen sequoia trees (the largest is named "Roosevelt Tree") lay along the smaller of the loop trails which are designated "National Recreation Trails." Hand thinning and piling is desired inside and along the small loop trail in the grove, while mechanical thinning is planned for the rest of the project.

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The overstory surrounding the sequoias is a balanced, yet with heavy stocking of ponderosa pine, Douglas-fir, sugar pine, white fir and incense cedar. Many of the trees are very large except for white fir, which is present in a few large trees and an overstocked understory. The largest non-sequoia tree observed was a Doug-fir estimated to be 84" dbh. Small openings in the grove are occupied with brush (alder, dogwood, manzanita, chinquapin, pine-mat manzanita and some bear clover). More than half the understory is densely-stocked with saplings, poles and larger-sized conifers, especially white fir. A small plantation containing off-site sequoia seedlings was established by the Lions Club in 1956. Most of these planted sequoias are suppressed and have poor growth form. Only one naturally-established giant sequoia regeneration tree is known to be present in the grove. This 12-foot sapling has been suppressed by several large overstory white fir trees which appear to have died at least a decade earlier. The growth of the suppressed sequoia has not increased significantly since.

The large pines, Doug-firs and incense cedars have full, healthy-looking crowns. A few of the white fir have healthy, full crowns; yet most of them have rounded tops, dead or dying branches or thinning foliage. A number of the largest white fir appear to have died within the last 10 to 15 years. The declining condition of the large white fir trees is a result of the combined stresses place on them by dwarf mistletoe (*Arceuthobium abietinum f.sp magnificae.*), heterobasidion root disease (caused by *Heterobasidion occidentale*), over-stocking and the fir engraver beetle (*Scolytus ventralis*). Appendix 2 contains discussions of the major insects and diseases present.

The District proposal for the grove is to reduce stocking as much as possible while maintaining the required 50% crown closure. The proposal to hand thin trees up to 6" dbh will not remove enough trees, in many areas, to improve stand health and vigor. The District might consider raising this proposed diameter limit for all conifers, especially white fir, to meet desired stocking objectives. Where possible, white fir should be favored for removal because many white fir are being stressed by root disease and dwarf mistletoe. White fir with declining crowns (thin foliage and dead branches) or short growth leaders have a higher probability of being infected with *H. occidentale.* Removing groups of diseased white fir will create openings where non-host trees could be planted. Of course any other tree with growth or disease issues should be removed as well.

It was noted that the giant sequoia trees planted by the Lion's Club are overtopped and growing poorly. The poor growth is probably due to overstocking and lack of sunlight; however it is possible that these trees are from off-site seed and not suited for this location. However, giant sequoia has been widely planted off-site throughout the world with success; so one or two of the Lions Club's giant sequoias may grow well if they could be adequately released from competition from both overstory and understory vegetation. The lack of giant sequoia regeneration in the Big Trees Grove is a significant issue affecting the long-term survival of the grove. By releasing a few of the existing understory giant sequoia trees from competition, and by planting giant sequoia seedlings in existing and newly-created openings the survival of sequoia trees in the Big Trees Grove can be enhanced. Additionally, exposing mineral soil in openings within range for seed dispersal from the existing native giant sequoia trees should result in successful

natural regeneration of sequoias in Big Trees Grove. The Sequoia NF has demonstrated that giant sequoia regenerates well from natural seeding following man-caused disturbances. Of course, seedlings planted in the grove should be obtained from local seed. Since the trees in the Big Trees Grove are in a recreation area and are considered aesthetically valuable, all freshly-cut conifer stumps should be treated with a borate fungicide to prevent infecting roots with *Heterobasidion* spp. which could result in perpetuating root disease in the grove. Stump treatment in recreation areas is required by FSM 2300, R5 Supplement No. 2300-92-1.

To protect the large pines, especially sugar pines, from cambium damage from heat resulting from the combustion of the large amount of duff at their bases, it is recommended to rake accumulated duff away from such trees before reintroducing fire.

Site 2 – Greek Plantation

The Greek plantation is approximately 1 mile NE of the Big Trees Grove and is located on a north-south ridge on a gentle south-facing aspect. This mostly ponderosa pine plantation is approximately 40 acres in size with a small (estimated 3 acre) island of large ponderosa and sugar pine, white fir, incense cedar and black oak. The "island" had recently been masticated for brush control. A few small sugar pine, white fir and black oak are scattered among the pine. Much of the plantation has a good stocking of pine trees 6 to 12 inches dbh but parts of the plantation appear under-stocked. The plantation is mostly over-grown with brush (manzanita, white thorn and cherry) which competes with the planted trees for soil moisture. The District proposal is to control the brush and reduce ponderosa pine stocking (within dense pockets) by mastication. Such a treatment would reduce the moisture stress on the small trees and may help to protect the plantation from wildfire. A couple of years after mastication, it will be necessary to treat the plantation with prescribed fire to remove fuels and brush undergrowth. No current insect or disease issues were identified; however the planned treatments should make the trees in the stand more resilient to future droughts and effects of the anticipated changing climate.

Site 3 – Greek Store Thinning

The Greek Store Thinning is approximately 0.5 mile east of the Big Trees Grove and is located on a east-facing aspect with up to 50% slopes. The stand is made up mostly of ponderosa pine with some sugar pine and white fir. The area was thinned recently and masticated. White pine blister rust is heavily impacting the small sugar pine resulting in twisted boles and mortality in trees up to 12" dbh. The area needs underburning before brush regrows and recreates a fuels problem for the stand. No current insect or other disease activity was observed.

Site 4 – Hand-treated stand near Greek Store Thinning

Just south and east of Site 3, a stand below the road was hand treated and piled to remove excess trees and reduce the fire danger. Many of the small white fir leave trees, 10 to 25 feet in height, had died since the treatment was completed approximately a year ago. The fir engraver beetle (*Scolytus ventralis*) was found in the dead fir. It is suspected that the piled fir slash attracted the beetles which killed the young trees growing under the now open-grown overstory conifers. Small white fir in the untreated stand above the road were unaffected.

Site 5 – Greek Store Recovery Act Thinning

This area is located approximately 0.5 miles south of the Big Trees Grove and north of the Spruce Creek Rd. The area is on a south aspect with slopes up to 30%. This area is composed of plantations and native stands of dense conifers that have been logged over in the past. The plantations are mostly made up of overstocked Doug-fir, ponderosa pine and white fir saplings. Brush is beginning to crowd the understory in many areas. This area needs to be thinned to enhance fire protection for the Big Trees Grove.
To maintain tree vigor and enhance future growth in the face of predicted climate change, this stand should be thinned to appropriate stand densities, piled and/or masticated. No current insect or disease activity was observed.

Site 6 – Biggie Units 3 and 4

Units 3 and 4 are located approximately 2 miles east and 0.5 miles south of Big Trees Grove. The units are on flat ground in a home range core area for spotted owls, which has a requirement to maintain 50% canopy closure. The overstory is mostly white fir with incense cedar, sugar pine, ponderosa pine and Douglas-fir also present. Some exposed white fir roots had a stringy decay, indicating that heterobasidion root disease is probably present. A number of large oaks in the units are currently over-topped and suppressed by the conifers. The units have been recently treated with prescribed fire and the brush is patchy. The large conifers have approximately 36-inch dbh's and one felled oak had a diameter approximately that large, as well. The average conifer dbh is estimated to be 24" and the average black oak tree is estimated to be 16" dbh. A small island of planted ponderosa pine, now approximately 14"-18" dbh, is present in Unit 3.

The District objectives are to thin the conifers down to the 50% canopy closure limit and to release the oaks from overstory competition. Individual pines or groups of pine would benefit by lower stocking levels. During thinning operations, conifers shading oaks will be favored for removal. Removing overstory conifers on only the south and east sides of the oak trees or clumps of trees will provide the most effective sunlight for tree growth, based on recent work done with aspen on the Lassen NF. After thinning, fuels will most likely be treated with an additional underburn.

Although heterobasidion root disease is most likely present, most of the large white fir have healthy-looking crowns. The disease has not yet significantly impacted these trees. During mechanical treatment and burning, care should be taken to protect the boles of healthy white fir from injury and infection by *H. occidentale.* Managers might consider favoring white fir for removal; this will shift the species composition to tree species unaffected by *H. occidentale.* Freshly cut conifer stumps, larger that 14" across should be treated with a borate fungicide to protect the stumps (and eventually, the roots) from infection by *H. occidentale*.

Note: This project is eligible for FHP funding through the Western Bark Beetle Initiative and is supported by this evaluation.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431 or Bill Woodruff at 530-252-6680.

/s/ Bill Woodruff *s/ Danny Cluck*

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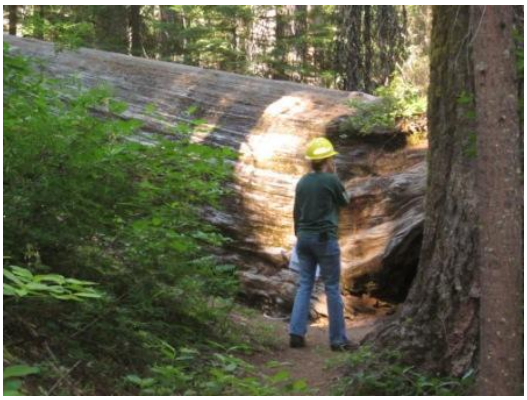
Appendix 1. Big Trees Grove Pictures

1. Map of Big Trees Grove

2. Joffre Tree



3. Fallen Roosevelt Tree

4. Pershing Tree fire scar

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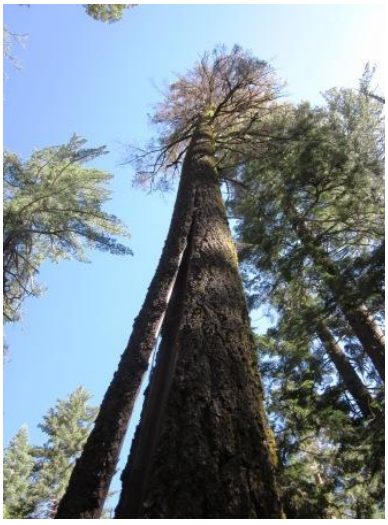
7. Crowded overstory conifers

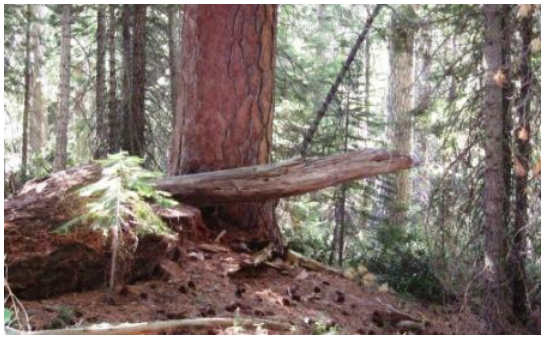
8. Brush and fuels on forest floor

9. Dead large white fir



10. Another dead large WF

11. A 3rd dead large WF



12. Duff and fuels threaten this pine

13. H. occidentale conk

Appendix 2: Insect and Disease Information

Fir Engraver

The fir engraver attacks red and white fir in California. Fir engraver adults and developing broods kill true firs by mining the cambium, phloem, and outer sapwood of the bole, thereby girdling the tree. Trees greater that 4" in diameter are attacked and often killed in a single season. Many trees, weakened through successive attacks, die slowly over a period of years. Others may survive attack as evidenced by old spike-topped fir and trees with individual branch mortality. Although many other species of bark beetles cannot develop successful broods without killing the tree, the fir engraver beetle is able to attack and establish broods when only a portion of the cambium area has been killed.

Evidence of Attack

Fir engravers bore entrance holes along the main stem, usually in areas that are > 4" in diameter. Reddish-brown or white boring dust may be seen along the trunk in bark crevices and in spider webs. Some pitch streamers may be indicative of fir engraver attacks; however, true firs are known to stream pitch for various reasons and there is not clear evidence that pitch streamers indicate subsequent tree mortality or successful attack. Resin canals and pockets in the cortex of the bark are part of the trees defense mechanism. Beetle galleries that contact these structures almost always fail to produce larval galleries as the adults invariably abandon the attack. Pitch tubes, often formed when bark beetles attack pine, are not produced on firs.

Adults excavate horizontal galleries that engrave the sapwood; the larval galleries extend at right angles along the grain. Attacks in the crown may girdle branches resulting in individual branch mortality or "flagging". Numerous attacks over part or the entire bole may kill the upper portion of the crown or the entire tree. A healthy tree can recover if sufficient areas of cambium remain and top-killed trees can produce new leaders. The fir engraver is frequently associated with the roundheaded fir borer and the fir flatheaded borer.

Life Stages and Development

In the summer, adults emerge and attack new host trees. The female enters the tree first followed by the male. Eggs are laid in niches on either side of the gallery. Adult beetles carry the brown staining fungi, *Trichosporium symbioticum*, into the tree that causes a yellowish-brown discoloration around the gallery. The larvae mine straight up and down, perpendicular to the egg gallery. Winter is commonly spent in the larval stage, with pupation occurring in early spring. In most locations, the fir engraver completes its life cycle in 1 year, however at higher elevations 2 years may be required.

Conditions Affecting Outbreaks

Fir engravers bore into any member of the host species on which they land but establish successful galleries only in those that have little or no resistance to attack. Populations of less aggressive species like fir engraver are likely to wax and wane in direct relationship to the stresses of their hosts. Drought conditions often result in widespread fir mortality; however, attempting to determine when outbreaks will occur is difficult. Lowered resistance of trees appears to be a contributing factor. Overstocking and the increased presence of fir on sites that were once occupied by pine species may also contribute to

higher than normal levels of fir mortality. Several insect predators, parasites and woodpeckers are commonly associated with the fir engraver and may help in control of populations at endemic levels.

Heterobasidion Root Disease

Heterobasidion spp. is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (*Arbutus menziesii*), and a few brush species (*Arctostaphylos spp.* and *Artemisia tridentata*) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all National Forests in California, with incidence particularly high on true fir in northern California, in the eastside pine type forests, and in southern California recreation areas.

Heterobasidion root disease is one of the most important conifer diseases in Region 5. Current estimates are that the disease infests about 2 million acres of commercial forestland in California, resulting in an annual volume loss of 19 million cubic feet. Other potential impacts of the disease include: increased susceptibility of infected trees to attack by bark beetles, mortality of infected trees presently on the site, the loss of the site for future production, and depletion of vegetative cover and increased probability of tree failure and hazard in recreation areas.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers are initiated when airborne spores produced by the conks land and grow on freshly cut stump surfaces. Infection in true fir may also occur through fire and mechanical wounds, or occasionally, through roots of stumps in the absence of surface colonization. From the infected stump surface, the fungus grows down into the roots and then spreads via root-to-root contact to adjacent live trees, resulting in the formation of large disease centers. These infection centers may continue to enlarge until they reach barriers, such as openings in the stand or groups of resistant plants. In pines, the fungus grows through root cambial tissue to the root crown where it girdles and kills the tree. In true fir and other non-resinous species, the fungus sometimes kills trees, but more frequently is confined to the heartwood and inner sapwood of the larger roots. It then eventually extends into the heartwood of the lower trunk and causes chronic decay and growth loss.

Heterobasidion root disease in western North America is caused by two species: *Heterobasidion occidentale* (also called the 'S' type) and *H. irregulare* (also called the 'P' type). These two species of *Heterobasidion* have major differences in host specificity. *H. irregulare* (‘P’ type) is pathogenic on ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense cedar, western juniper, pinyon, and manzanita. *H. occidentale* (‘S’ type) is pathogenic on true fir, spruce and giant sequoia. This host specificity is not apparent in isolates from stumps; with *H. occidentale* being recovered from both pine and true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for many years. Young conifers established near these stumps often die shortly after their roots contact infected roots in the soil.

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Dwarf Mistletoe

Dwarf mistletoes (Arceuthobium spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts.

Dwarf mistletoes uniquely spread by means of seed explosively discharged in the fall from ripe fruit growing on aerial shoots of mistletoe plants. The seed are covered with a sticky substance and adhere to whatever they contact. When a seed lands on a host tree, it can stick to a needle where it sometimes moves to the base of the needle in water from winter precipitation. In the spring the seed germinates and penetrates the twig at grows. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causes the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height in the tree from where they are discharged. There is some evidence that long distance spread of dwarf mistletoe is occasionally vectored by birds and mammals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year, on average because of foliage density and its reproductive-cycle. Because of the thin crowns of gray pine, however, the vertical rate of spread has been measured as being greater than 2 feet per year. This rate of spread equaled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed within a tree's crown. Signs of infection include the yellow-green to orange mistletoe plants or “basal cups” on branches from which the dwarf mistletoe plants grew. Also, detached dwarf mistletoe plants on the ground beneath an infected tree are easily observed. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.

White pine blister rust

White pine blister rust is caused by Cronartium ribicola an obligate parasite that attacks 5-needled pines and several species of Ribes spp. The fungus needs the two alternate hosts to survive, spending part of its life on 5-needle pines and the other on Ribes spp. The disease currently occurs throughout the range of 5-needle pines in California north of the Tehachepe Mountains. Infection of pines results in cankers on branches and main stems, branch mortality, top kill, and tree mortality.

Spores (aeciospores) produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to Ribes spp. where they infect the leaves. Spores (urediospores) produced in orange pustules on the underside of the leaves reinfect other Ribes leaves and plants throughout the summer, resulting in an intensification of the rust. A telial spore stage forms on Ribes spp. leaves in the fall. Teliospores germinate in place to produce spores (sporida) which are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After 2 or 3 years, spores are produced on the cankers and are spread to Ribes spp. to continue the cycle. Although blister rust may spread hundreds of miles from pines to Ribes spp., its spread from Ribes spp. back to pines is usually limited to a few hundred feet.

Branch cankers continue to enlarge as the fungus invades additional tissues and moves toward the bole. Branch cankers within 24 inches of the bole will eventually form bole cankers. Bole cankers result in girdling and death of the tree above the canker. Cankers that have margins more than 24 inches from the main bole are unlikely to reach the bole and only branch flagging will result.